SPECIFICATION

GOLF CLUB HEAD AND GOLF CLUB

Technical Field

The present invention relates to a golf club head provided with a hollow portion which is surrounded by an outer shell member and to a golf club having such a golf club head.

Prior Art

It has come to be known in recent years that a coefficient of restitution of a golf ball can be increased by using a titanium alloy or the like in the golf ball-striking surface of a hollow golf club head made of metal. In addition, the coefficient of restitution can be increased by making a face member that constitutes the striking surface thinner, or by making a joining edge portion where the face member joins to another member such as a crown member or a sole member partially thinner. An outer shell member of such golf club head is formed by a method in which members made from substantially similar metallic materials are joined together by welding, brazing, and so forth.

On the other hand, an internal pressure molding method is also known. An outer shell member of a golf club head is placed in a predetermined molding die, a bag or bladder is inserted within a hollow portion of the golf club head that is surrounded by the outer shell member, and an internal pressure is imparted to the bladder with high temperature air introduced in the bladder, thus expanding the bladder and applying a pressure from the inside of the hollow portion. The outer shell member can thus be molded into a predetermined shape. The term "bladder" refers to a bag-like element composed of a freely expandable nylon material or the like. Air can be filled into such a bladder at a predetermined temperature so as to mold the outer shell member of a golf club head into a desired shape.

However, with the internal pressure molding method, small holes are formed in the inserted bladder during a long use, thus causing air leaks, depending upon the structure of the golf club head to be manufactured. Accordingly, a predetermined internal pressure is not reached, and the outer shell member cannot be molded into the desired shape, causing a problem of molding defects.

There is also a production problem in that such defects of a bladder are not visible. There are many cases where lots of manufactured golf club heads must then be

treated as defective units since defects in a bladder only come to light by examining molded golf club heads one by one after manufacturing golf clubs in a large quantity.

In order to solve the problems described above, an object of the present invention is to provide a golf club head in which the rate of molding failure upon molding by using a bladder can be lowered so that the golf club head can be manufactured with good efficiency while ensuring the characteristics of a golf club head having a hollow portion and to provide a golf club which has such a golf club head.

Disclosure of the Invention

The present invention provides a golf club head comprising an outer shell member and a hollow portion surrounded by the outer shell member, wherein: an inner surface of the hollow portion includes either or both of a concave surface and a flat surface and a projecting portion is formed on the inner surface; and the projecting portion is so formed that it has a convex surface with a radius of curvature equal to or greater than 3 mm, or chamfered by chipping off a corner edge of an angular portion, where two surfaces of the projecting portion intersect at an angle, by 3 mm or more along the two surfaces.

The projecting portion as above is assumed to be a

convex portion projecting from the surface of the hollow portion by 3 mm or more. A metallic mass for adjusting the center of gravity provided on a sole portion, a part of a neck portion projecting into the hollow portion, or the like corresponds to the projecting portion. The expression "chamfered by chipping off by 3 mm or more" should be understood to mean the chamfering at a level of "C3 or more" as defined by the JIS B0701-1987 standard.

The convex surface is provided by using, for instance, a sheet material comprising a resin for the surface of the projecting portion. The sheet material may comprise a fiber reinforced resin material.

The outer shell member is formed by joining at least two members together by bonding and the members are joined together by bonding preferably when the outer shell member is molded by an application of a pressure from the inside of the hollow portion toward the outside.

Preferably, the golf club head further comprises a columnar neck member having a shaft insertion hole into which a golf club shaft is inserted, the hole being closed at one end, wherein the neck member projects into the hollow portion and its end on a projection side is so formed that the end has a convex surface with a radius of curvature equal to or greater than 3 mm, or chamfered by

chipping off a corner edge of an angular portion, where two surfaces of the end on the projection side intersect at an angle, by 3 mm or more along the two surfaces.

In that case, it is more preferable that a lateral surface of the columnar neck member on a heel side is joined to the outer shell member and covered with a joining surface of the outer shell member so that a concave space may not be formed between the lateral surface on the heel side and the outer shell member within the hollow portion.

The lateral surface of the neck member on the heel side is to be understood as the heel-side half of the lateral surface of the columnar neck member as evenly divided into two halves on the heel side and the toe side.

The present invention also provides a golf club head comprising an outer shell member and a hollow portion surrounded by the outer shell member, wherein an inner surface of the hollow portion includes either or both of a concave surface and a flat surface and the inner surface has no projecting portion formed thereon.

The present invention further provides a golf club which has a grip, a golf club shaft, and a golf club head, wherein: the golf club head comprises an outer shell member and a hollow portion surrounded by the outer shell member; an inner surface of the hollow portion includes either or

both of a concave surface and a flat surface and a projecting portion is formed on the inner surface; and the projecting portion is so formed that it has a convex surface with a radius of curvature equal to or greater than 3 mm, or chamfered by chipping off a corner edge of an angular portion, where two surfaces of the projecting portion intersect at an angle, by 3 mm or more along the two surfaces.

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Brief Description of the Drawings

Fig. 1 is an exploded perspective view schematically showing an embodiment of the golf club head which the golf club of the present invention has. Fig. 2A shows a section A-A of the golf club head of Fig. 1, taken along a line A-A. Fig. 2B shows a section A'-A' of the golf club head of Fig. 1, taken along a line A'-A'. Fig. 2C is an illustrative

diagram showing another example of the projecting portion. Fig. 3 is a partial cross-sectional view of the golf club head shown in Fig. 2B, taken along a line B-B. Fig. 4 is a diagram for explaining internal pressure molding carried out during the manufacture of the golf club head of the present invention. Fig. 5 is a sectional view showing the structure of another embodiment of the golf club head of the present invention. Fig. 6 is a sectional view showing a golf club head structure other than that shown in Fig. 2B.

Best Mode of Implementing the Invention

The golf club head of the present invention is described in detail below based on preferred embodiments shown in the accompanying drawings.

Fig. 1 is an exploded perspective view schematically showing a golf club 1 which has a golf club head 10 that is an embodiment of the golf club head of the present invention.

The golf club 1 has the golf club head 10, a golf club shaft 2, a grip 4 and a socket 6. The golf club head 10 is connected to one end of the golf club shaft 2 through the socket 6. The grip 4 is provided at the other end of the golf club shaft 2.

The golf club head 10 as shown in Fig. 1 is provided with a face portion that strikes a golf ball, a crown portion that is connected to the face portion, and a sole portion that is connected to the face portion, and has a crown member 12 that forms the major part of the crown portion, a side member 14 that mainly forms the side portion, a sole member 16 that forms the sole portion, and a face member 18 that mainly forms the face portion and is provided with a golf ball-striking surface, each as an outer shell component, as well as a columnar neck member 20 that has a shaft insertion hole 19 closed at one end, into which the golf club shaft 2 is inserted.

The side member 14, the sole member 16, and the face member 18 are integrated with one another by welding in advance. In the side member 14, an extension portion 22 is provided which has an edge curving to a crown portion side, extending to the crown portion and forming a part of the crown portion. In the face member 18, an extension portion 24 is provided which has an edge curving to the crown portion side, extending to the crown portion and forming a part of the crown portion. That is, the side member 14, the sole member 16, and the face member 18 are previously integrated with one another to become a state as shown in Fig. 1. The crown member 12 is then joined to the

extension portions 22 and 24 by using an adhesive, the golf club head 10 being thus constructed.

Various types of alloy materials may be used for the side member 14, the sole member 16, and the face member 18, such as a titanium alloy, an aluminum alloy, or a stainless steel alloy.

The crown member 12 is structured by using a composite material in which a plurality of layers of a carbon fiber reinforced plastic material having different orientation angles are laminated together. An epoxy resin, an unsaturated polyester resin, a vinyl ester resin, or the like may be used as a matrix. It should be noted that reinforcing fibers other than carbon fibers, such as glass fibers, aramid fibers, and PBO (poly(p-phenylene-benzobisoxazole)) fibers, may also be used in the present invention. In addition, various types of alloy materials, such as magnesium alloys, aluminum alloys, and titanium alloys, may also be used in the crown member 12, apart from composite materials.

Fig. 2A shows a section A-A of the golf club head 10 of Fig. 1, taken along a line A-A. Fig. 2B shows a section A'-A' of the golf club head 10 of Fig. 1, taken along a line A'-A'. Fig. 3 is a partial cross-sectional view of the golf club head 10 shown in Fig. 2B, taken along a line

B-B (line perpendicular to the central axis of the shaft insertion hole 19).

As shown in Fig. 2A, a hollow portion 26 is formed in the golf club head 10, as being surrounded by the crown member 12, the side member 14, and the sole member 16. A metallic mass 28 for adjusting the center of gravity is provided in a surface of the sole member 16 in the hollow portion 26 as a projecting portion that projects into the hollow portion 26. An angular portion of the metallic mass 28 is formed by a surface (curved surface) having a radius of curvature equal to or greater than 3 mm. It should be noted that the term "projecting portion that projects into the hollow portion 26" refers to a portion that projects from a surface of the outer shell member comprising the crown member 12, the side member 14, and the sole member 16 by 3 mm or more perpendicularly to a region of the surface in the neighborhood of the portion.

Further, the neck member 20 projects into the hollow portion 26. As shown in Fig. 2B, the lateral surface of the neck member 20 on the heel side is welded to the side member 14, and is thus integral with the outer shell member comprising the crown portion 12, the side member 14, and the sole member 16. The welding of the neck member 20 to the side member 14 is performed so that a narrow concave

space may not be formed between the lateral surface of the neck member 20 on the heel side and the side member 14. As shown in Fig. 3, the lateral surface of the neck member 20 on the heel side is covered with a joining surface 14a of the side member 14. In addition, an end portion 20a of the neck member 20 on the projection side is formed by a curved surface having a radius of curvature equal to or greater than 3 mm.

According to the present invention, it is also possible to chamfer the angular portions of the projecting portion and the end portion of the neck member on the projection side at a level of C3 or more instead of forming the projecting portion and the end of the neck member on the projection side so that they may have a surface with a radius of curvature equal to or greater than 3 mm as described above. The denotation "C3" indicates that chamfering is carried out by chipping off the corner edge of an angular portion, where two surfaces intersect at an angle, by 3 mm along the two surfaces. Accordingly, the chamfering at a level of "C3 or more" is carried out by chipping off the corner edge of an angular portion by 3 mm or more along the two intersecting surfaces. Such chamfering is defined by the JIS B0701-1987 standard.

The golf club head 10 is thus structured.

The projecting portion that projects into the hollow portion of the golf club head of the present invention may also be made by covering the surface of a projecting member with a sheet member so as to obtain a projecting portion having a radius of curvature equal to or greater than 3 mm, as shown in Fig. 2C. By using a sheet member comprising a fiber reinforced plastic material, for instance, the projecting portion having a curved surface with a radius of curvature equal to or greater than 3 mm is obtained during the molding of the outer shell member. It should be noted that the present invention is not limited to wood-type golf club heads but applied to any golf club head as long as it has a hollow structure.

The golf club head 10 as described above is obtained by integrating the side member 14, the sole member 16, and the face member 18 with one another by welding in advance as shown in Fig. 1, and then joining the crown member 12 with the extension portions 22 and 24 by using an adhesive.

Internal pressure molding is then performed as shown in Fig. 4.

Specifically, the golf club head 10, in a state where the bonded joining surfaces are partially dry, is disposed in a predetermined molding die 30. A pipe 34 having a nylon bladder 32 at its one end is inserted into the hollow

portion 26 from a through hole 16a formed in the sole member 16. The pipe 34 is connected to a supply apparatus that supplies high temperature air, and supplies a desired amount of air at a desired temperature. The through hole 16a that is formed in the sole member 16 is closed with a closing member after internal pressure molding.

As shown in Fig. 4, high temperature air, for example, air at 150°C, is supplied within the bladder 32 up to nearly 5 (kgf/cm^2) to cause the bladder 32 to expand within the hollow portion 26 and, in addition, cause the outer shell member composed of the crown member 12, the side member 14, the sole member 16, and the face member 18 to expand. In this respect, angular portions 28a and 28b of the metallic mass 28 and the end portion 20a of the neck member 20 are formed by surfaces having a radius of curvature equal to or greater than 3 mm, the shaft insertion hole 19 of the neck member 20 projecting into the hollow portion 26 is closed at the end on the projection side, and, moreover, a narrow concave space is not formed between the lateral surface of the neck member 20 on the heel side and the side member 14, so that there are no protrusions or recesses within the hollow portion 26 which may cause defects in the freely expandable bladder 32. The probability of defects occurring in the bladder 32 can thus

be made low.

Since the outer shell member is disposed in the molding die 30 at this point, its expansion is restrained in accordance with the shape of the inner surface of the molding die 30 and, in consequence, the outer shell member assumes the shape corresponding to that of the inner surface of the molding die 30. For example, the crown member 12 composed of a composite material is molded into the shape corresponding to that of the inner surface of the molding die 30 as a result of the deformation due to heat and pressure. At the same time, a joining surface of the crown member 12 and joining surfaces of the extension portions 22 and 24 are pressed in a high temperature state so that the curing of an adhesive is promoted under pressure and the crown member 12 is strongly bonded to the side member 14 and the face member 18.

The crown member 12 is joined with the side member 14 and the face member 18 by bonding in the embodiment described above. However, there are no particular limitations in the present invention to members that are to be joined by bonding. For example, the sole member 16 may also be joined with the side member 14 and the face member 18 by bonding.

In addition, in the golf club head of the present

invention, the surface of the hollow portion which is located inside the head, as being surrounded by the outer shell member, may be formed by a concave surface or a flat surface.

Fig. 5 shows another embodiment of the golf club head of the present invention.

A golf club head 50 shown in Fig. 5 is structured such that a surface of a hollow portion 52 is formed by concave surfaces 54a through 54d and flat surfaces 56a and 56b, and a neck member 58 does not project into the hollow portion 52.

The probability of defects occurring in a bladder can be reduced also when the golf club head 50 having the above structure is molded using a bladder as described above because no protrusions or recesses exist within the hollow portion 52 which may develop defects in a freely expandable bladder.

Examples

Hollow golf club heads of a structure as shown in Fig. 1 were manufactured and the rate of failure in golf club head molding was determined.

The crown member 12 used for the manufacture was

structured by using a composite material in which four layers of a carbon fiber reinforced plastic material were laminated. The side member 14, the sole member 16, and the face member 18 were structured by using a titanium alloy material. After welding the side member 14, the sole member 16, and the face member 18 together, these members were bonded to the crown member 12 by using a specified adhesive. The golf club head thus fabricated was expanded from the inside and molded by using the bladder 32 as shown in Fig. 4.

For the golf club heads manufactured as Examples 1, 2 and 3 as well as Comparative Examples 1 and 2, the specifications as shown in Tables 1 and 2 below had been set.

In Examples 1 and 2, edge removal from the projecting portion was carried out by rounding off the angular portion of the projecting portion so as to allow the projecting portion to have a surface with a radius of curvature equal to or greater than 3 mm. In Example 3, a sheet member comprising a fiber reinforced plastic material (FRP sheet) was used to allow the projecting portion to have a curved surface with a radius of curvature equal to or greater than 3 mm as shown in Fig. 2C, the edge removal from the projecting portion being thus effected. Joining of the

neck member was performed in two ways as follows. Specifically, the joining was carried out such that the lateral surface of the neck member 20 projecting into the hollow portion 26 was covered with the joining surface of the side member 14 entirely on the heel side according to the embodiment as shown in Fig. 3 so that a narrow concave space might not be formed between the lateral surface of the neck member 20 on the heel side and the side member 14, as described before. According to another embodiment as shown in Fig. 6, the lateral surface of a neck member 62 projecting into a hollow portion 60 was joined with the joining surface of a side member 64 partly on the heel side.

Table 1

	Edge removal from projecting portion	Shaft insertion hole	Joining of neck member	Molding failure rate (%)
Example 1	Removed	Closed	Fig. 3	0.5
Example 2	Removed	Closed	Fig. 6	1
Comparative Example 1	Not removed	Closed	Fig. 6	7
Comparative Example 2	Not removed	Through	Fig. 6	15

[0023a]

Table 2

	Edge removal from projecting portion	Shaft insertion hole	Joining of neck member	Molding failure rate (%)
Example 3	Removed (FRP sheet)	Closed	Fig. 3	0.6

Five types of golf club heads whose specifications were as shown in the tables were manufactured, four hundred each in number, and the defectively molded heads were counted. The molding failure rate (%) was determined as shown in Table 1.

The term "defectively molded" or "molding failure" means that the crown member is incompletely joined by bonding because of the defects (holes) developed in the bladder 32 as shown in Fig. 4 that lead to the failure in

molding under a predetermined inner pressure. The molding failure as such can be found out by checking whether or not air bubbles are generated from the joining surface of the crown member when the manufactured golf club head is immersed in water.

As seen from Tables 1 and 2, the rate of molding failure was extremely low in Examples 1, 2 and 3 compared to the rate of molding failure in Comparative Examples 1 and 2, which indicates that efficient manufacturing was accomplished for the three Examples. Further, the metallic mass used for adjusting the center of gravity can be provided in the hollow portion, similar to a conventional golf club head, and therefore the characteristics of the golf club head do not change.

The golf club head of the present invention has been described in detail above. However, the present invention is not limited to the above Examples. It is, of course, also possible to make various types of modifications and changes without deviating from the gist of the present invention.

Industrial Applicability

As described in detail above, according to the

present invention, the surface of the hollow portion of the golf club head includes either or both of a concave surface and a flat surface. On the other hand, the projecting portion provided on the surface of the hollow portion, if any, is so formed that it has a convex surface with a radius of curvature equal to or greater than 3 mm, or chamfered at a level of C3 or more. In consequence, the golf club head can be manufactured with good efficiency even if the inner pressure molding is performed using a bladder because the rate of molding failure upon such molding is reduced while the characteristics of the golf club head are ensured.